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Reviewed for Addressee

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ADMIN RECORD

cc: Daniel S. Miller, AGO

Jackie Berardini, CDH-OE

Martin Hestmark, EPA

Arturo Duran, EPA

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STATE OF COLORADO

COLORADO DEPARTMENT OF HEALTH  
Dedicated to protecting and improving the health and  
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EG&G  
ROCKY FLATS PLANT  
CORRESPONDENCE CONTROL



Roy Romer  
Governor

Patricia A. Nolan, M  
Executive Director

April 23, 1993

Mr. Richard J. Schassburger  
U.S Department of Energy  
Rocky Flats Plant  
Building 116  
P. O. Box 928  
Golden, Colorado 80402-0928

RE: COMMENTS; Technical Memorandum (TM-4) Human Health Risk  
Assessment Exposure Scenarios (to the FINAL, Phase I, RFI/RI  
WORKPLAN), ROCKY FLATS PLANT, Solar Evaporation Ponds (Operable  
Unit No. 4), March 1993

Dear Mr. Schassburger:

The Colorado Department of Health, Hazardous Materials and Waste  
Management Division (the Division) and the U. S. Environmental Agency  
(EPA) have reviewed the subject document submitted by DOE and prime  
contractor, EG&G. The Division's comments, and those submitted by  
EPA, are attached.

The Division, as lead regulatory agency, hereby withholds approval.  
The extensive comments must be satisfactorily resolved before  
approval will be granted.

We invite DOE and its contractors to meet with the EPA and the  
Division to expeditiously resolve these issues. A meeting should be  
arranged quickly such that DOE delivers a revised document no later  
than May 28, 1993.

If you have any questions concerning the attached comments, please  
call Harlen Ainscough of my staff at 692-3337.

Sincerely,

*Gary W. Baughman*  
Gary W. Baughman, Chief

Facilities Section  
Hazardous Waste Control Program

Attachments

cc: Daniel S. Miller, AGO  
Jackie Berardini, CDH-OE  
Martin Hestmark, EPA  
Arturo Duran, EPA  
Frazer Lockhart, DOE  
Scott Surovchek, DOE  
Wanda Bushy, EG&G

A-0000-001087

Colorado Department of Health  
Hazardous Materials & Waste Management Division

Comments

on

DRAFT FINAL

TECHNICAL MEMORANDUM (No. 4)

HUMAN HEALTH RISK ASSESSMENT EXPOSURE SCENARIOS

(Addendum to Final Phase I RFI/RI Work Plan)

for

SOLAR EVAPORATION PONDS

OU-4

ROCKY FLATS PLANT

MARCH, 1993

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General Comments:

Technical Memorandum Number 4 was well written. Tables, Figures, and Appendices were clearly referenced in the document and included in marked sections at the end of the document. The summary tables enhance readability.

In general, the technical memorandum lacks appropriate evaluation of exposures to subsurface soils. At times, soil exposures (surface and subsurface soil) are assessed generically. For example, potentially complete human exposure pathways for the current onsite workers are listed as inhalation of airborne particulates; incidental soil ingestion from direct contact; direct dermal contact with site soils; and groundshine (Direct Contact). The soil pathway does not distinguish between surface and subsurface soil. This is not acceptable.

Specific Comments:

Section 1.0: The term "source materials" is vague. As the Division, EPA, and DOE may have different interpretations of the term, DOE should define how it characterized "source materials" for evaluation.

Section 2.4: The wind rose shown in Fig. 2-3 is different from that used for OU1 for supposedly the same year.

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**Section 2.7:** Understanding of the ecology will be enhanced with a brief summary (6-7 sentences) of the ecology in the public health evaluation rather than a reference to the RFI/RI Work Plan for OU4 or to the Ecological Evaluation.

**Section 3.0:** The reference cited throughout this section of the TM, DOE 1990, uses 1980 census data. Census data for 1990 has been available for some time and should be incorporated in all RFP documents, including this one.

**Section 3.1:** An elementary school is identified as a sensitive subpopulation facility located near the plant. Consequently, this group should be evaluated separately for all complete exposure pathways.

Is the information in this section and in the 3.2 Offsite Land Use section consistent with the latest information and projections available? For example, W-470 is defunct. Why is this highway still being used as part of the rationale for assuming commercial, light industrial and office parks will be built in the area rather than residential development?

Using a 1989 population projection from 1980 data is not acceptable. In addition, the estimate of zero population growth in the area immediately adjacent to the plant boundary is highly suspect given the change in plant mission.

A map should be provided showing the locations of the schools, hospitals and nursing homes within a 10 mile radius of RFP.

**Section 3.2.1:** The last sentence in the first paragraph of this section should be changed to read "The northeastern Jefferson County and RFP includes one of the most . . ."

**Section 3.2.2:** Industrial land-use will probably not "dominate" future land-use in northeastern Jefferson county, particularly given the plant mission change and the pace of residential development in the area.

Reference to Highway W-470 is obsolete since this project is currently defunct.

The first paragraph on page 3-5 uses outdated information from the same report (DOE, 1990) mentioned earlier. Mission change and community perceptions have changed.

The last paragraph in this section is also inaccurate. Current land use in the immediate vicinity of RFP is not primarily commercial/industrial. It is predominantly low density agricultural and residential which can be seen from DOE's inclusion of the land use map and Table 3-2 in this document.

**Section 3.3.2:** On page 3-6, the text states that occupation by private industry is planned for future use of the on-site production areas. This issue should be revisited in light of potential changes brought about by the new administration and Energy Secretary. Also, there are many inherent problems with private industry using portions of RFP that DOE has been unable to coherently address at this time.

The Rocky Flats Local Impacts Initiative (RFLII) is not "working to achieve" private industry use of RFP. They are evaluating this as one option to minimize economic impacts to the surrounding communities from the changing plant mission.

It is clear that the authors of this section of the text need to receive clarification on these issues from knowledgeable DOE sources. This information should not be coming from the cited sources (Denver Post, Boulder Daily Camera, RFLII).

The second paragraph on page 3-8 states that the buffer zone is being considered as a potential ecological preserve. What the text does not state, but needs to, is that this is only one of several potential uses under consideration. In light of the mission change, many more land use options have become viable.

At the bottom of page 3-8 the text states that extensive development of the area is unlikely. Again, mission change has made this statement less certain.

The last paragraph of this section is entirely wrong for the previously stated reasons.

**Section 3.4:** In general, the agricultural scenario bounds the residential scenario. The state has taken this position in response to technical memorandum for OU2 and OU7. Unlike the residential scenario, the agricultural scenario always includes consumption of homegrown produce and sometimes includes consumption of homegrown livestock.

The justification for not evaluating the agricultural scenario is inconsistent with previous statements. One, industrial development takes as much or more water as ranching. Two, the plant is currently surrounded by agriculture.

Future on-site residential uses are not inconsistent with planned off-site industrial and commercial development. The RFP buffer zone is very large and could easily allow both residential and industrial/commercial land-uses to co-exist. Residential developments are the predominant land-use off-site and are increasingly encroaching on the immediate borders of the buffer zone. The Standley Lake-Louisville-Superior residential area is one of the fastest growing portions of the Denver-Metro area. Water resources are presently not a limiting factor for development

and are not anticipated to be in the future. Given the change in plant mission, future on-site residential developments are no longer "improbable". Whether residential land-use is consistent with outdated DOE plans is no longer relevant.

The text states "EPA guidance does not require an exhaustive assessment of every potential receptor and exposure scenario". This may be true, however all potential receptors must be identified and compared to determine the likelihood of harm.

**Section 3.5:** Figure 3-7 is not clear. The scale on the map is too small, and the markers for the three future onsite receptors are too large to delineate the location. The current onsite worker marker could not be found on this map. The future onsite worker location must be clarified. A more appropriate map would include the OU4 boundary, the proposed area for an open space and the location of the solar ponds area and the hillside area.

Before the Division can approve the method of aggregating exposure source data into two groups, DOE must provide a map clearly defining the location of the data points that will be aggregated into each group. Also, the receptors in each group must be identified.

**Section 3.5.1:** If employees use the roadway below the ponds and hillside for recreational jogging and walking, how will their risks be evaluated? Will the risks of jogging near OU4 be bounded by another scenario?

Although DOE's efforts to protect workers are comprehensive, accidents occur, and personal protective clothing (the least preferred method of worker protection) often fails. DOE's ability to keep workers at or below the 500 mrem/year guideline is commendable, but there are risks involved with any exposures to radiation. The risks associated with actual exposures must be evaluated despite any worker protection programs, and the risk levels for current workers must be calculated and compared to the accepted IAG risk of  $10^{-6}$ . It is not necessary to compare current worker exposures to chemicals and radionuclides to TLVs or STELs.

**Section 3.5.2:** The Division has not received a copy of the Rocky Flats Plant Site Environmental Report for 1991. The same report for 1990 estimated maximum individual doses from all pathways (for 1990) to be 0.52 mrem (effective dose equivalent) in addition to natural background.

**Section 3.5.3:** To suggest that future industrial development is likely to include well maintained landscaping is misleading. Currently, the industrial complex has minimal landscaping, and there are not any plans to develop industrial areas in which landscaping would be desirable.

**Section 3.5.4:** The exposure area marked in Figure 3-7 for the ecological researcher is too limited. An open space area may encompass the entire OU.

**Section 3.5.5:** The last sentence of the first paragraph should refer to a construction worker and not an ecological researcher.

**Section 4.3:** A map should be provided indicating the location of the current residential receptor. From the statement, it is not clear how close the receptor is to OU4.

The Division requires that hot-spot specific risk assessments be performed as well as the OU-site-wide risk assessments.

**Section 4.4:** When possible, all chemicals of concern should be assessed quantitatively if they are associated with a complete exposure pathway and exceed background levels. This includes metals and radionuclides, the only chemicals which should be compared to background.

If an organic compound is present, it should by definition be considered anthropogenic, and should not be eliminated from the COC list by comparing it to background. If VOCs are detected, they should be included in the selection process for contaminants of concern. If they are infrequently detected or detected at low concentrations, they will, most likely be eliminated by the COC screen.

External irradiation should be included in the exposure pathways.

**Section 4.5.1:** Inhalation of volatiles in outdoor and indoor air by future onsite residents should be evaluated since a complete exposure pathway is likely.

The reference to direct contact exposures being incomplete for current off site residents is misleading. These receptors will be evaluated for exposures that involve direct contact after wind-blown deposition. They do not have access to the Rocky Flats site, and in that sense, will not have direct contact. This should be clarified.

Before the Division can agree that onsite airborne particulate exposure "would be relatively insignificant" it must review any data showing the times workers are at the pond sites and any data indicating measured or modelled onsite particulate values. In addition, see comment on Section 3.5.1.

**Section 4.5.2.1:** The paragraph concerning external irradiation is confusing. It states that "contaminated surface soils (groundshine) is also a potentially complete but insignificant exposure pathway", and "external radiation from direct contact with the soil will be evaluated as a potentially complete exposure

pathway for the current onsite worker." Do these two sentences refer to two different types of soil?

**Section 4.5.2.2:** Please refer to comments on section 4.4.

The Division has made this comment previously for both OU7 and OU2. Plant uptake of metals tightly bound to soil can and does occur. A wide variety of plants have been shown to actively concentrate metals. This process is very species dependent, and site and soil-dependent. Solubility, dissociation or speciation in water, soil-sorption coefficients, cation-exchange ratios, and reactivity all are very dependent upon specific site conditions such as pH, organic content of the soil, moisture, etc. Therefore, plant uptake from soil as well as surface contamination of vegetation should be considered quantitatively for both offsite residential and onsite exposure scenarios at Rocky Flats. It cannot be assumed that conditions that applied at Leadville will apply at this site.

The argument that tilling will dilute surface deposition of particulates is not consistent with the on-site residential scenario discussed on page 4-14. It cannot be assumed that off-site residents will till the soil while on-site residents will not. These receptors must be treated consistently either one way or the other.

Why is off-site external radiation resulting from windborne radioactive contamination not being considered for off-site residents?

**Section 4.5.2.3:** The second to last paragraph should read, "Exposure to radioactive materials via inhalation, oral, or dermal uptake routes other than external irradiation is accounted for in the other potentially complete exposure pathways described for this receptor."

The Division does not agree that, "Chemicals bound to soil particles suspended and transported by the wind" necessarily "represent negligible oral and dermal exposure pathways". They may be negligible relative to inhalation exposures to windborne contaminants, but this doesn't necessarily mean they are negligible in an absolute sense. Dermal absorption of some organic compounds can occur rapidly, and depends upon such factors as the amount of soil on the skin surface, the lipid solubility of the chemical and the volatility of the chemical (T. McKone. Dermal Uptake of Organic Chemicals from a Soil Matrix. Risk Analysis, 10(3):407-418, 1990). DOE must justify such statements in order for them to be comprehensively reviewed and accepted.

**Section 4.5.2.4:** Simply because "the impact of incidental ingestion of contaminated soil and dermal absorption of chemicals in soil following wind deposition are considered to be negligible" compared to direct ingestion and dermal exposure to site soils does

not mean that these pathways can be ignored. Assess them and then determine whether they are significant or not.

**Section 4.5.2.5:** Subsoil exposures must be considered for this receptor. Simply because a pathway is minor relative to another does not mean it should not be assessed. This is a baseline risk assessment which requires a complete estimate of the sitewide risk.

The construction worker scenario enables the evaluation of potential acute and subchronic exposures in addition to chronic exposures.

**Section 4.5.2.6:** To suggest that oral and dermal exposures from wind deposition of particulates to the future onsite resident will be negligible compared to direct contact with the soils does not dismiss the need for the evaluation of the additive effects of exposure to both media. The Division would like to see the contribution to the total risk resulting from this exposure pathway as well as the major pathways in this baseline risk assessment. Exposure to airborne contaminants is considered by DOE to be the major exposure pathway for current offsite residents (page 4-8 this report). It should also be considered for onsite receptors.

What are the washoff factors for evaluating particulate deposition pathway mentioned in the last sentence on page 4-14? These factors have not been previously discussed.

**Section 5.0:** The Division does not agree with the idea that "Because contact rates (except for soil ingestion) are approximately proportional to body weight, child residential intakes are not estimated separately for any exposure pathway except soil ingestion, for which children are assumed to have higher daily intake rates". Children are often among the more sensitive populations to the risks resulting from chemical or radionuclide exposure. Inhalation exposures are a case in point. Total deposition of air particles in the respiratory tract for children is higher than that for adults (Xu and Yu, Aerosol Science and Technology, 5:349-357, 1986). In addition, because of their higher activity levels and lower body weights compared to adults, children generally receive greater total daily intakes of air pollutants than either infants or adults. Therefore, DOE must quantitatively estimate child residential exposures for all exposure pathways, not just for soil ingestion. In general, the Division requests that childhood exposures be assessed at all sites for which risk assessments are performed in Colorado.

**Section 5.1.1:** The RME exposure duration for current ponds workers should consider the time involved in future monitoring activities and the possibility that the ponds will not be closed as scheduled.

The Division is uncomfortable with the use of 60 day snowcover to decrease the number of days exposed to dust. There is always some



exposure to indoor dust, and snow creates mud. Moreover, it is not clear if the 60 day groundcover includes all ground or neglects south-facing slopes which melt more quickly? Before the Division can accept this factor, a stronger justification needs to be made by DOE.

**Section 5.1.2:** Tables 5-2, 5-6, 5-10, 5-14, 5-19. Twenty-five percent of inhaled particles are deposited in the deep tissue of the lung; seventy-five percent of inhaled particles are deposited in the upper respiratory passages and subsequently swallowed and retained in the body. (MRI 1985)

Because baseline risk assessments are concerned with overall health effects of inhalation and not simply lung effects the usual value used for depositional fractions is 75%. A wide variety of sources indicate that 25% is too low a value for a depositional fraction. These include the soil dust inhalation estimates of Hawley (Risk Analysis 5:(4)289-302, 1985), the US EPA's "Second addendum to air quality criteria for particulate matter and sulfur oxides (1982)", (EPA600/8-86-020f), and the International Commission on Radiological Protection, (ICRP,1980) study which states that for aerosols with a mean aerodynamic diameter between 0.2 um and 20 um, the sum of the fractions deposited in the three regions of the respiratory tract varies from about 60% to 90% . If applied at all, a value of 75% is recommended.

The factor for exposure duration should reflect the actual time the current pond workers are at the site which is eight hours.

**Section 5.1.3:** Soil matrix effects are dependent on a variety of factors including soil loading, surface area exposed, site of application, soil organic content, and the chemical of concern. Without the appropriate site specific and chemical specific data to justify the use of a soil matrix factor, such factors will not be accepted.

Contaminants of concern must be identified after the soil matrix factor has been applied. Otherwise, the concentration-toxicity screen may be biased. A chemical that is extremely toxic but tightly bound to soil may bump another contaminant that is less toxic but more bioavailable.

The use of any fractional intakes is unacceptable if:

1. site-specific data is not used to support the value. Literature values alone do not constitute site-specific data.
2. it causes considerable deviation from an RME estimate.

The Division will not accept any intake value that is based on area instead of time. DOE is proposing to use the relative areas of OU4

to the whole buffer area to calculate the 0.006 fractional intake value for the ecological worker and construction worker receptors. Depending upon the research project, it is entirely conceivable that an ecological researcher could spend the vast majority of time in one area like OU4, without going to another area of the buffer zone at all. A similar situation could also apply to a construction worker. Averaging the exposure over the whole RFP buffer zone will essentially dilute out any exposure, and is not protective in the remotest sense.

The 0.125 fractional intake for future onsite workers assumes that the worker is outside for one hour (lunch) out of an eight hour day. The factor must consider indoor dust which is affected by outdoor dust.

The 0.5 fractional intake values do not reference any supporting data for the assumption that people spend only half their time at home. The assumption is inappropriate. The inhalation values used from EPA's guidance assume 24 hour exposure and were derived with housewives, invalids, and children (some of whom make up the most susceptible populations), who would be at home 24 hours/day.

Section 5.1.4: The duration of exposure to homegrown produce is not limited to the four month harvesting season. Many people preserve the produce by canning or drying it.

DOE did not calculate the ingestion of homegrown produce correctly. EPA guidance (the same one referenced by DOE) recommends a typical consumption of 140 g/day of fruit and 200 g/day of vegetables. The reasonable worst case proportion of produce that is homegrown is assumed to be 30% and 40%, respectively. This guidance recommends exposure for 350 days/year.

Concerning the soil matrix factors, see comments on section 5.1.3.

Section 5.1.5: The Division must review the chemical specific data on which the absorbed fractions are based before these fractions can be approved.

Why has DOE chosen to use the midpoint of the range (0.6 mg/cm<sup>2</sup>)?

The Division does not agree with the choice of 2190 cm<sup>2</sup> surface area for all receptors. It is not reasonable that residents would expose only the face, forearms, and hands (15% of total body surface). An adult default value of 5000-5800 cm<sup>2</sup> is recommended in EPA's Dermal Exposure Assessment (1992). This value was derived by applying 25% to the total average adult body surface area. A 25% factor was used instead of 15% because some studies have suggested that exposure can occur under clothing.

Concerning the soil matrix factors, see comments on section 5.1.3.

Section 5.1.6: Given that an estimate of the radionuclide intake will be expressed in units of radioactivity, intake must be a function of the energy emitted from the radionuclide and the frequency and duration of exposure to the radioactive material. The use of the word concentration is imprecise.

How will internal and external exposure be combined so that pathways can be summed to estimate total exposure and risk?

The approach does not consider known effects of the radionuclides. For example, plutonium is a lung carcinogen. Why not use a systemic body burden of a lung count?

Section 5.2: The estimates of dose equivalent do not need to be compared to radiation protection standards and criteria. They should simply be used to calculate risk.

Section 5.2.1: It seems reasonable that different fractional exposures could be applied to the Hillside areas and to the Solar Ponds area based on relative times the workers use each site. This seems a more reasonable approach than basing fractional intakes on area.

Table 3-2: What does the zoning code M-C mean?

Table 3-4: Footnote "c" for Current offsite agricultural receptors is inconsistent with previous statements made in 3.4. It states that this receptor, which is not being considered, bounds the current offsite residential land use scenario. If this is true, then the agricultural scenario should be evaluated.

Tables 5-1, 5-5, 5-9, 5-13, 5-17, 5-18: The fraction ingested from contaminated sources should always be considered to be 1.0.

Tables 5-2, 5-6, 5-10, 5-14, 5-19: See comment to Section 5.1.2.

Table 5-11, 5-15, 5-20: EPA recommends 5,000-5800 cm<sup>2</sup> for surface area. It is reasonable to assume that these receptors only expose their faces, forearms, and hands to surface soil.

#### APPENDIX A:

Page A-2. In the second paragraph, "These samplers are part of...?"

Sampler S-4. Sampler S-4 is due north of the B-series ponds. Thus this sampler may measure plutonium concentrations that reflect worker exposures in OU4. However, this sampler is not downwind from the predominant wind direction. Therefore, it must be remembered that higher concentrations of plutonium, other

radionuclides and chemicals may be evaporating off the solar ponds than indicated by this monitor.

Table 1. It is not clear why the volumes sampled on the different dates vary. If samples are taken only until a set level of radioactivity is detected, it should be stated somewhere. Are these samples normalized before they are compared?

Page A-10. The text here states, "The measurements were taken from January through December 1991", and refers to Table V. Table V states the measurements are for 1992. Which is the correct year?

Page A-10. It is unclear from the text whether the external dosimetry summation reports for solar pond workers in Table V show exposures only to plutonium or to gross alpha radiation produced by other radionuclides. Is plutonium the only radionuclide at the solar ponds?

Table V. This table does not show the mean, standard deviations or 95% UCLs for skin and hand exposures. It only shows the deep values.

#### Appendix C:

A clear delineation of the samples taken from surface soil and from subsurface soil was never made in the VOC discussion. This needs to be done in order to determine the likely receptors that could be exposed to any chemicals present.

EPA's methodology for calculating PRGs which was used to estimate the concentrations of VOCs in soils associated with acceptable levels of risk or hazard explicitly states that site-specific information be used. How well do the default values listed in Table 2 Appendix C and used to calculate the "action level concentrations" shown in Table 1 reflect the conditions at Rocky Flats? For example, do Rocky Flats soils have an organic content close to 2%? What is the average soil moisture content at Rocky Flats? Why was an exposure interval, T, equivalent to 25 years used? If enough data is available to define the extent of contamination at this OU, the Division would prefer that the actual size of individual hot spots be used, instead of the default value of 45 m for the length of a side of the contaminated area.

How do the VOC levels found in the Phase I samples compare to the action levels calculated? This information needs to be reviewed and approved by the Division before DOE can go forward with the decision not to include inhalation of VOCs as an exposure pathway. In addition, VOCs emitted into basements could be a route of exposure for future office workers and residents on site. Therefore, workers are not the only population likely to be exposed to VOCs as indicated on page B-4, and the Division requests that inhalation of indoor VOCs be included for these two receptors as

well as inhalation of outdoor VOCs for construction workers exposed to subsurface soil.